

## SCIENCE AND PEACE

by

Linus Pauling

Nobel Lecture, Oslo

7 P.M., 11 December 1963

I believe that there will never again be a great world war - a war in which the terrible weapons involving nuclear fission and nuclear fusion would be used. And I believe that it is the discoveries of scientists upon which the development of these terrible weapons was based that is now forcing us to move into a new period in the history of the world, a period of peace and reason, when world problems are not solved by war or by force, but are solved in accordance with world law, in a way that does justice to all nations and that benefits all people.

Let me again remind you, as I did yesterday in my address of acceptance of the Nobel Peace Prize for 1962, that Alfred Nobel wanted to invent "a substance or a machine with such terrible power of mass destruction that war would thereby be made impossible forever". Two thirds of a century later scientists discovered the explosive substances that Nobel wanted to invent - the fissionable substances uranium and plutonium, with explosive energy <sup>ten</sup> ~~one~~ million times that of Nobel's favorite explosive, nitroglycerine, and the fusionable substance lithium deuteride, with explosive energy <sup>fifty</sup> ~~seven~~ million times that of nitroglycerine. The first of the terrible machines incorporating these substances, the uranium-235 and plutonium-239 fission bombs, were exploded in 1945, at Alamogordo, Hiroshima, and Nagasaki. Then in 1954, nine years later, the first of the fission-fusion-fission

superbombs was exploded, the 20-megaton Bikini bomb, with energy of explosion one thousand times greater than that of a 1945 fission bomb.

This one bomb, the 19~~54~~ superbomb, contained less than one ton of nuclear explosive. The energy released in the explosion of this bomb was greater than that of all of the explosives used in all of the wars that have taken place during the entire history of the world, including the First World War and the Second World War.

Thousands of these superbombs have now been fabricated; and today, eighteen years after the construction of the first atomic bomb, the nuclear powers have stockpiles of these weapons so great that if they were to be used in a war hundreds of millions of people would be killed, and our civilization itself might not survive the catastrophe.

Thus the machines envisaged by Nobel have come into existence, and war has been made impossible forever.

The world has now begun its metamorphosis from its primitive period of history, when disputes between nations were settled by war, to its period of maturity, in which war will be abolished and world law will take its place. The first great stage of this metamorphosis took place only a few months ago - the formulation by the governments of the United States, Great Britain, and the Soviet Union, after years of discussion and negotiation, of a treaty banning the testing of nuclear weapons on the surface of the earth, in the oceans, and in space, and the ratification and signing of this treaty by nearly all of the nations in the world.

I believe that the historians of the future may well describe the making of this treaty as the most important action ever taken by the governments of

nations, in that it is the first of a series of treaties that will lead to the new world, from which war has been abolished forever.

We see that science and peace are related. The world has been greatly changed, especially during the last century, by the discoveries of scientists. Our increased knowledge now provides the possibility of eliminating poverty and starvation, of decreasing significantly the suffering caused by ~~tuberculosis~~ ~~the~~ disease, of using the resources of the world effectively for the benefit of humanity. But the greatest of all the changes has been in the nature of war - the several millionfold increase in the power of explosives, and corresponding changes in methods of delivery of bombs.

These changes have resulted from the discoveries of scientists, and during the last two decades scientists have taken a leading part in bringing them to the attention of their fellow human beings and in urging that vigorous action be taken to prevent the use of the new weapons and to abolish war from the world.

The first scientists to take actions of this sort were those involved in the development of the atomic bomb. In March 1945, before the first nuclear explosion had been carried out, Leo Szilard prepared a memorandum to President Franklin Delano Roosevelt in which he pointed out that a system of international control of nuclear weapons might give civilization a chance to survive. A committee of atomic scientists with James Franck as Chairman on 11 June 1945 transmitted to the U.S. Secretary of War a report urging that nuclear bombs not be used in an unannounced attack against Japan, as this action would prejudice the possibility of reaching an international agreement on control of these weapons.

In 1946 Albert Einstein, Harold Urey, and seven other scientists formed an

organization to educate the American people about the nature of nuclear weapons and nuclear war. This organization, the Emergency Committee of Atomic Scientists (usually called the Einstein Committee), carried out an effective educational campaign over a five-year period. The nature of the campaign is indicated by the following sentences from the 1946 statement by Einstein:

"Today the atomic bomb has altered profoundly the nature of the world as we know it, and the human race consequently finds itself in a new habitat to which it must adapt its thinking. ... Never before was it possible for one nation to make war on another without sending armies across borders. Now with rockets and atomic bombs no center of population on the earth's surface is secure from surprise destruction in a single attack. ... Few men have ever seen the bomb. But all men if told a few facts can understand that this bomb and the danger of war is a very real thing, and not something far away. It directly concerns every person in the civilized world. We cannot leave it to generals, senators, and diplomats to work out a solution over a period of generations. ... There is no defense in science against the weapon which can destroy civilization. Our defense is not in armaments, nor in science, nor in going underground. Our defense is in law and order. ... Future thinking must prevent wars."

During the same period and later years many other organizations of scientists were active in the work of educating the people about nuclear weapons and nuclear war; among them I may mention especially the Federation of American Scientists (in the United States), the Atomic Scientists' Association (Great Britain), and the World Federation of Scientific Workers (with membership covering many countries).

On 15 July 1955 a powerful statement, called the Mainau Declaration, was issued by fifty-two Nobel Laureates. This statement warned that a great war in the nuclear age would imperil the whole world, and ended with the sentences "All nations must come to the decision to renounce force as a final resort of policy. If they are not prepared to do so they will cease to exist."

A document of great consequence, the Russell-Einstein Appeal, was made public by Bertrand Russell on 9 July 1955. Russell, who for years has remained

one of the world's most active and effective workers for peace, had drafted this document some months earlier, and it had been signed by Einstein two days before his death, and also by nine other scientists. The Appeal began with the sentence

"In the tragic situation which confronts humanity, we feel that scientists should assemble in conference to appraise the perils that have arisen as a result of the development of weapons of mass destruction ...",

and it ended with the exhortation

"There lies before us, if we choose, continual progress in happiness, knowledge, and wisdom. Shall we, instead, choose death, because we cannot forget our quarrels? We appeal, as human beings, to human beings: Remember your humanity, and forget the rest. If you can do so, the way lies open to a new Paradise; if you cannot, there lies before you the risk of universal death."

This Appeal led to the formation of the Pugwash Continuing Committee, with Bertrand Russell as Chairman, and to the holding of a series of Pugwash Conferences (eleven during the years 1957 to 1963). Financial support for the first few conferences was provided by Mr. Cyrus Eaton, and the first conference was held in his birthplace, the village of Pugwash, Nova Scotia.

Among the participants in some of the Pugwash Conferences have been scientists with a close connection with the governments of their countries, as well as scientists without government connection. The Conferences have permitted the scientific and practical aspects of disarmament to be discussed informally in a thorough, penetrating, and productive way, and have led to some valuable proposals. It is my opinion that the Pugwash Conferences were significantly helpful in the formulation and ratification of the 1963 Bomb-test-ban Treaty.

Concern about the damage done to human beings and the human race by the radioactive substances produced in nuclear weapons tests was expressed with in-

creasing vigor in the period following the first fission-fusion-fission bomb test at Bikini on 1 March 1954. Mention was made of radioactive fallout in the Russell-Einstein Appeal and also in the statement of the First Pugwash Conference. In his Declaration of Conscience issued in Oslo on 24 April 1957 Dr. Albert Schweitzer described the damage done by fallout and asked that the great nations cease their tests of nuclear weapons. Then on 15 May 1957, with the help of some of the scientists in Washington University, St. Louis, I wrote the Scientists' Bomb-test Appeal, which within two weeks was signed by over two thousand American scientists and within a few months by 11,021 scientists, of 49 countries. On 15 January 1958, as I presented the Appeal to Dag Hammarskjold as a petition to the United Nations, I said to him that in my opinion it represented the feelings of the great majority of the scientists of the world.

The Bomb-test Appeal consists of five paragraphs. The first two are the following:

"We, the scientists whose names are signed below, urge that an international agreement to stop the testing of nuclear bombs be made now."

"Each nuclear bomb test spreads an added burden of radioactive elements over every part of the world. Each added amount of radiation causes damage to the health of human beings all over the world and causes damage to the pool of human germ plasm such as to lead to an increase in the number of seriously defective children that will be born in future generations."

Let me now say a few words to amplify the last statement, about which there has been controversy. Each year, of the nearly 100 million children born in the world, about 4,000,000 have gross physical or mental defect, such as to cause great suffering to themselves and their parents and to constitute a major burden on society. Geneticists estimate that about five percent, 200,000 per year, of these children are grossly defective because of gene mutations caused by natural high-energy radiation - cosmic rays and natural radioactivity, from

which our reproductive organs cannot be protected. This numerical estimate is rather uncertain, but geneticists agree that it is of the right order of magnitude.

Moreover, geneticists agree that any additional exposure of the human reproductive cells to high-energy radiation produces an increase in the number of mutations and an increase in the number of defective children born in future years, and that this increase is approximately proportional to the amount of the exposure.

The explosion of nuclear weapons in the atmosphere liberates radioactive fission products - cesium 137, strontium 90, iodine 131, and many others. In addition, the neutrons that result from the explosion combine with nitrogen nuclei in the atmosphere to form large amounts of a radioactive isotope of carbon, carbon 14, which then is incorporated into the organic molecules of every human being. These radioactive fission products are now damaging the pool of human germ plasm and increasing the number of defective children born.

Carbon 14 deserves our special concern. It was pointed out by the Soviet scientist O. I. Leipunsky in 1957 that this radioactive product of nuclear tests would cause more genetic damage to the human race than the radioactive fallout (cesium 137 and other fission products), if the human race survives over the 8000-year mean life of carbon 14. Closely agreeing numerical estimates of the genetic effects of bomb-test carbon 14 were then made independently by me and by Drs. Totter, Zelle, and Hollister of the United States Atomic Energy Commission. Especially pertinent is the fact that the so-called "clean" bombs, involving mainly nuclear fusion, produce when they are tested more carbon 14 per megaton than the ordinary fission bombs or fission-fusion-fission bombs.

A recent study by Reidar Nydal, of the Norwegian Institute of Technology, in Trondheim, shows the extent to which the earth is being changed by the tests

of nuclear weapons. Carbon  $^{14}$  produced by cosmic rays is normally present in the atmosphere, oceans, and biosphere in amount such as to be responsible for between one and two percent of the genetic damage caused by natural high-energy radiation. Nydal has reported that the amount of carbon  $^{14}$  in the atmosphere has been more than doubled because of the nuclear weapons tests of the last ten years, and that in a few years the carbon- $^{14}$  content of human beings will be two or three times the normal value, with a consequent increase in the gene mutation rate and the number of defective children born.

Some people have pointed out that the number of grossly defective children born as a result of the bomb tests is small compared with the total number of defective children, and have suggested that the genetic damage done by the bomb tests should be ignored. I, however, have contended, as have Dr. Schweitzer and many others, that every single human being is important, and that we should be concerned about every additional child that is caused by our actions to be born to live a life of suffering and misery. President Kennedy in his broadcast to the American people on 26 July 1963 said

"The loss of even one human life, or the malformation of even one baby - who may be born long after we are gone - should be of concern to us all. Our children and grandchildren are not merely statistics towards which we can be indifferent."

We should know how many defective children are being born because of the bomb tests. During the last six years I have made several attempts to estimate the numbers. My estimates have changed somewhat from year to year, as new information became available and as continued bomb testing increased the amount of radioactive pollution of the earth, but no radical revision of the estimates has been found necessary.

It is my estimate that about 100,000 viable children will be born with gross physical or mental defects caused by the cesium  $^{137}$  and other fission



products from the bomb tests carried out from 1952 to 1963, and 1,500,000 more, if the human race survives, with gross defects caused by the carbon 14 from these bomb tests. In addition, about ten times as many embryonic, neonatal, and childhood deaths are expected - about 1,000,000 caused by the fission products and 15,000,000 by carbon 14. An even larger number of children may have minor defects caused by the bomb tests; these minor defects, which are passed on from generation to generation rather than being rapidly weeded out by genetic death, may be responsible for more suffering in the aggregate than the major defects.

About five percent of the fission-product effect and 0.3 percent of the carbon-14 effect may appear in the first generation; that is, about 10,000 viable children with gross physical or mental defect and 100,000 embryonic, neonatal, and childhood deaths.

These estimates are in general agreement with those made by other scientists and by national and international committees. The estimates are all very uncertain, because of the deficiencies in our knowledge. The uncertainty is usually expressed by saying that the actual numbers may be only one fifth as great or may be five times as great as the estimates, but the errors may be even larger than this.

Moreover, it is known that high-energy radiation can cause leukemia, bone cancer, and some other diseases. Scientists differ in their opinion about the cancerogenic activity of small doses of radiation, such as produced by fallout and carbon 14. It is my opinion that bomb-test strontium 90 can cause leukemia and bone cancer, iodine 131 can cause cancer of the thyroid, and cesium 137 and

carbon 14 can cause these and other diseases. I make the rough estimate that because of this somatic effect of these radioactive substances that now pollute the earth about 2,000,000 human beings now living will die five or ten or fifteen years earlier than if the nuclear tests had not been made. The 1962 estimate of the United States Federal Radiation Council was 0 to 100,000 deaths from leukemia and bone cancer in the U.S. alone caused by the nuclear tests to the end of 1961.

The foregoing estimates are for 600 megatons of bombs. We may now ask: At what sacrifice is the atmospheric test of a single standard 20-megaton bomb carried out? Our answer, none the less horrifying because uncertain, is — With the sacrifice, if the human race survives, of about 500,000 children, of whom about 50,000 are viable but have gross physical or mental defects; and perhaps also of about 70,000 people now living, who may die prematurely of leukemia or some other disease caused by the test.

We may be thankful that most of the nations of the world have, by subscribing to the 1963 treaty, agreed not to engage in nuclear testing in the atmosphere. But what a tragedy it is that this treaty was not made two years earlier! Of the total of 600 megatons of tests so far, three quarters of the testing, 450 megatons, was done in 1961 and 1962. The failure to formulate a treaty in 1959 or 1960 or 1961 was attributed by the governments of the United States, Great Britain, and the Soviet Union to the existing differences of opinion about methods of inspection of underground tests. These differences were not resolved in 1963; but the treaty stopping atmospheric tests was made. What a tragedy for humanity that the governments did not accept this solution before taking the

terrible step of resuming the nuclear tests in 1961!

I shall now quote and discuss the rest of the nuclear-test-ban petition of six years ago.

"So long as these weapons are in the hands of only three powers an agreement for their control is feasible. If testing continues, and the possession of these weapons spreads to additional governments, the danger of outbreak of a cataclysmic nuclear war through the reckless action of some irresponsible national leader will be greatly increased.

"An international agreement to stop the testing of nuclear bombs now could serve as a first step toward a more general disarmament and the ultimate effective abolition of nuclear weapons, averting the possibility of a nuclear war that would be a catastrophe to all humanity.

"We have in common with our fellow men a deep concern for the welfare of all human beings. As scientists we have knowledge of the dangers involved and therefore a special responsibility to make those dangers known. We deem it imperative that immediate action be taken to effect an international agreement to stop the testing of all nuclear weapons."

How cogent is this argument? Would a great war, fought with use of the nuclear weapons that now exist, be a catastrophe to all humanity?

Consideration of the nature of nuclear weapons and the magnitude of the nuclear stockpiles gives us the answer: it is Yes.

A single 25-megaton bomb could largely destroy any city on earth, and kill most of its inhabitants. Thousands of these great bombs have been fabricated, together with the vehicles to deliver them.

Precise information about the existing stockpiles of nuclear weapons has not been released. The participants in the Sixth Pugwash Conference, in 1960, made use of the estimate 60,000 megatons. This is 10,000 times the amount of explosive used in the whole of the Second World War. It indicates that the world's stockpile of military explosives has on the average doubled every year since 1945. My estimate for 1963, which reflects the continued manufacture of

nuclear weapons during the past three years, is 320,000 megatons.

This estimate is made credible by the following facts. On 12 November 1961 the U. S. Secretary of Defense stated that the U. S. Strategic Air Command then included 630 B-52's, 55 B-58's, and 1000 B-47's, a total of 1,685 great bombers. These bombers carry about 50 megatons of bombs apiece - two 25-megaton bombs on each bomber. Accordingly these 1,685 intercontinental bombers carry a load totaling 84,000 megatons. I do not believe that it can be contended that the bombs for these bombers do not exist. The Secretary of Defense also stated that the United States has over 10,000 other planes and rockets capable of carrying nuclear bombs in the megaton range. The total megatonnage of nuclear bombs tested by the Soviet Union is twice that of those tested by the United States and Great Britain, and it is not unlikely that the Soviet stockpile is also a tremendous one, perhaps one third or one half as large as the U. S. stockpile.

The significance of the estimated total of 320,000 megatons of nuclear bombs may be brought out by the following statement: if there were to take place tomorrow a 6-megaton war, equivalent to the Second World War in the power of the explosives used, and another such war the following day, and so on, day after day, for 146 years, the present stockpile would then be exhausted - but, in fact, this stockpile might be used in a single day, the day of the Third World War.

Many estimates have been made by scientists of the probable effects of hypothetical nuclear attacks. One estimate, reported in the 1957 Hearings before the Special Subcommittee on Radiation of the Joint Committee on Atomic Energy of the Congress of the United States, was for an attack on population and industrial centers and military installations in the United States with

250 bombs totalling 2500 megatons. The estimate of casualties presented in the testimony, corrected for the increase in population since 1957, is that 60 days after the day on which the attack took place 98 million of the 190 million American people would be dead, and 28 million would be seriously injured but still alive; many of the remaining 70 million survivors would be suffering from minor injuries and radiation effects.

This is a small nuclear attack, made with use of about one percent of the existing weapons. A major nuclear war might well see a total of 30,000 megatons, one tenth of the estimated stockpiles, delivered and exploded over the populated regions of the United States, the Soviet Union, and the other major European countries. The studies of Hugh Everett III and George E. Pugh, of the Weapons Systems Evaluation Division, Institute of Defense Analyses, Washington, D. C., reported in the 1959 Hearings before the Special Subcommittee on Radiation, permit us to make an estimate of the casualties of such a war. This estimate is that 60 days after the day on which the war was waged 720 million of the 800 million people in these countries would be dead, 60 million would be alive but severely injured, and there would be 20 million other survivors. The fate of the living is suggested by the following statement by Everett and Pugh: "Finally, it must be pointed out that the total casualties at 60 days may not be indicative of the ultimate casualties. Such delayed effects as the disorganization of society, disruption of communications, extinction of livestock, genetic damage, and the slow development of radiation poisoning from the ingestion of radioactive materials may significantly increase the ultimate toll."

No dispute between nations can justify nuclear war. There is no defense against nuclear weapons that could not be overcome by increasing the scale of

the attack. It would be contrary to the nature of war for nations to adhere to agreements to fight "limited" wars, using only "small" nuclear weapons - even little wars today are perilous, because of the likelihood that a little war would grow into a world catastrophe.

The only sane policy for the world is that of abolishing war.

This is now the proclaimed goal of the nuclear powers and of all other nations.

We are all indebted to the governments of the United States, the Soviet Union, and Great Britain for their action of formulating a test-ban agreement that has been accepted by most of the nations of the world. As an American, I feel especially thankful to our great President, John F. Kennedy, whose tragic death occurred only nineteen days ago. It is my opinion that this great international agreement could not have been formulated and ratified except for the conviction, determination, and political skill of President Kennedy.

The great importance of the 1963 test-ban treaty lies in its significance as the first step toward disarmament. To indicate what other steps need to be taken I shall now quote some of the statements made by President Kennedy in his address to the United Nations General Assembly on the 26th of September, 1961:

"The goal (of disarmament) is no longer a dream. It is a practical matter of life or death. The risks inherent in disarmament pale in comparison to the risks inherent in an unlimited arms race. ...

"Our new disarmament program includes....:

"First, signing the test-ban treaty by all nations...

"Second, stopping production of fissionable materials and preventing their transfer to (other) nations...;

"Third, prohibiting the transfer of control over nuclear weapons to other nations;

"Fourth, keeping nuclear weapons from outer space;

"Fifth, gradually destroying existing nuclear weapons;

"And Sixth, halting...the production of strategic nuclear delivery vehicles, and gradually destroying them."

The first of these goals has been approached, through the 1963 treaty, but not yet reached. Six weeks ago, by the vote 97 to 1, the Political Committee of the United Nations General Assembly approved a resolution asking that the 18-nation Disarmament Committee take supplementary action to achieve the discontinuance of all test explosions of nuclear weapons for all time. We must strive to achieve this goal.

The fourth action proposed by President Kennedy, that of keeping nuclear weapons from outer space, was taken two months ago, in the United Nations, through a pledge of abstention subscribed to by many nations.

Action on the third point, the prevention of the spread of nuclear weapons, could lead to a significant diminution in international tensions and in the chance of outbreak of a world war. The 1960 treaty making Antarctica a nuclear-free zone provides a precedent. Ten Latin-American nations have proposed that the whole of Latin America be made into a second zone free of nuclear weapons, and a similar proposal has been made for Africa. Approval of these proposals would be an important step toward permanent peace.

Even more important would be the extension of the principle of demilitarization to Central Europe, as proposed by Rapacki, Kennan, and others several years ago. Under this proposal the whole of Germany, Poland, and Czechoslovakia, and perhaps some other countries, would be largely demilitarized, and their boundaries and national integrity would be permanently assured by the United Nations. I am not able at the present time to discuss in a thorough way the complex

problem of Berlin and Germany; but I am sure that if a solution other than nuclear destruction is ever achieved, it will be through demilitarization, not remilitarization.

President Kennedy, President Johnson, Chairman Khrushchev, Prime Minister Macmillan, and other national leaders have proclaimed that, to prevent the cataclysm, we must move toward the goal of general and complete disarmament, we must begin to destroy the terrible nuclear weapons that now exist, and the vehicles for delivering them. But instead of destroying the weapons and the delivery vehicles, the great nations continue to manufacture more and more of them, and the world remains in peril.

Why is no progress being made toward disarmament? I think that part of the answer is that there are still many people, some of them powerful people, who have not yet accepted the thesis that the time has now come to abolish war. And another part of the answer is that there exists a great nation that has not been accepted into the world community of nations - the Chinese Peoples Republic, the most populous nation in the world. I do not believe that the United States and the Soviet Union will carry out any major stage of the process of disarmament unless that potential great nuclear power, the Chinese Peoples Republic, is a signatory to the disarmament agreement; and the Chinese Peoples Republic will not be a signatory to such a treaty until she is accepted into the community of nations, under conditions worthy of her stature. To work for the recognition of China is to work for world peace.

We cannot expect the now existing nuclear weapons to be destroyed for several years, perhaps for decades. Moreover, there is the possibility, mentioned by Philip Noel Baker in his Nobel Lecture in 1959, that some nuclear



weapons might be concealed or surreptitiously fabricated, and then used to terrorize and dominate the disarmed world; this possibility might slow down the program of destroying the stockpiles.

Is there no action that we can take immediately to decrease the present great danger of outbreak of nuclear war, through some technological or psychological accident or as the result of a series of events such that even the wisest national leaders could not avert the catastrophe?

I believe that there is such an action, and I hope that it will be given consideration by the national governments. My proposal is that there be instituted with the maximum expedition compatible with caution a system of joint national-international control of the stockpiles of nuclear weapons, such that use could be made of the American nuclear armaments only with the approval both of the American government and of the United Nations, and that use could be made of the Soviet nuclear armaments only with the approval both of the Soviet government and of the United Nations. A similar system of dual control would of course be instituted for the smaller nuclear powers, if they did not destroy their weapons.

Even a small step in the direction of this proposal, such as the acceptance of United Nations observers in the control stations of the nuclear powers, might decrease significantly the probability of nuclear war.

There is another action that could be taken immediately to decrease the present great hazard to civilization. This action would be to stop, through a firm treaty incorporating a reliable system of inspection, the present great programs of development of biological and chemical methods of waging war.

Four years ago the scientists participating in the Fifth Pugwash Conference concluded that at that time the destructive power of nuclear weapons was far larger than that of biological and chemical weapons, but that biological and chemical weapons have enormous lethal and incapacitating effects against man and could also effect tremendous harm by the destruction of plants and animals. Moreover, there is a vigorous effort being made to develop these weapons to the point where they <sup>would</sup> become a threat to the human race equal to or greater than that of nuclear weapons. The money expended for research and development of biological and chemical warfare by the United States alone has now reached 100 million dollars per year, an increase of sixteenfold in a decade, and similar efforts are probably being exerted in the Soviet Union and other countries.

To illustrate the threat I may mention the plans to use nerve gases that, when they do not kill, produce temporary or permanent insanity, and the plans to use toxins, such as the botulism toxin, viruses, such as the virus of yellow fever, or bacterial spores, such as of anthrax, to kill tens or hundreds of millions of people.

The hazard is especially great in that, once the knowledge is obtained through a large-scale development program such as is now being carried out, it might well spread over the world, and might permit some small group of evil men, perhaps in one of the smaller countries, to launch a devastating attack.

This terrible prospect could be eliminated now by a general agreement to stop research and development of these weapons, to prohibit their use, and to renounce all official secrecy and security controls over microbiological,

toxicological, pharmacological, and chemical-biological research. Hundreds of millions of dollars per year are now being spent in the effort to make these malignant cells of knowledge.

Now is the time to stop. When once the cancer has developed, and its metastases have spread over the world, it will be too late.

The replacement of war by law must include not only great wars but also small ones. The abolition of insurrectionary and guerrilla warfare, which often is characterized by extreme savagery and a great amount of human suffering, would be a boon to humanity.

There are, however, countries in which the people are subjected to continuing economic exploitation and to oppression by a dictatorial government, which retains its power through force of arms. The only hope for many of these people has been that of revolution, of overthrowing the dictatorial government and replacing it with a reform government, a democratic government that would work for the welfare of the people.

I believe that the time has come for the world as a whole to abolish this evil, through the formulation and acceptance of some appropriate articles of world law. With only limited knowledge of law, I shall not attempt to formulate a proposal that would achieve this end without permitting the possibility of the domination of the small nations by the large nations. I suggest, however, that the end might be achieved by world legislation under which there would be, perhaps once a decade, a referendum, supervised by the United Nations, on the will of the people with respect to their national government, held, separately from the national elections, in every country in the world.

It may take many years to achieve such an addition to the body of world law. In the meantime, much could be done through a change in the policies of the great nations. During recent years insurrections and civil wars in small countries have been instigated and aggravated by the great powers, which have moreover provided weapons and military advisors, increasing the savagery of the wars and the suffering of the people. In four countries during 1963 and several others during preceding years democratically elected governments with policies in the direction of social and economic reform have been overthrown and replaced by military dictatorships, with the approval, if not at the instigation, of one or more of the great powers. These actions of the great powers are associated with policies of militarism and national economic interest that are now antiquated. I hope that the pressure of world opinion will soon cause them to be abandoned, and to be replaced by policies that are compatible with the principles of morality, justice, and world brotherhood.

In working to abolish war we are working also for human freedom, for the rights of individual human beings. War and nationalism, together with economic exploitation, have been the great enemies of the individual human being. I believe that, with war abolished from the world, there will be improvement in the social, political, and economic systems in all nations, to the benefit of the whole of humanity.

I am glad to take this opportunity to express my gratitude to the Norwegian Storting for its outstanding work for international arbitration and peace during the last seventy five years. In this activity the Storting has been the leader among the parliaments of nations. I remember the action of the

Storting in 1895 of urging that permanent treaties for arbitration of disputes between nations be made, and the statement that "The Storting is convinced that this idea has the support of an overwhelming proportion of our people. Just as law and justice have long ago replaced the rule of the fist in disputes between man and man, so the idea of settling disputes among peoples and nations is making its way with irresistible strength. More and more, war appears to the general consciousness as a vestige of prehistoric barbarism and a curse to the human race."

Now we are forced to eliminate from the world forever this vestige of prehistoric barbarism, this curse to the human race. We, you and I, are privileged to be alive during this extraordinary age, this unique epoch in the history of the world, the epoch of demarcation between the past millenia of war and suffering and the future, the great future of peace, justice, morality, and human well-being. We are privileged to have the opportunity of contributing to the achievement of the goal of the abolition of war and its replacement by world law. I am confident that we shall succeed in this great task; that the world community will thereby be freed not only from the suffering caused by war but also, through the better use of the earth's resources, of the discoveries of scientists, and of the efforts of mankind, from hunger, disease, illiteracy, and fear; and that we shall in the course of time be enabled to build a world characterized by economic, political, and social justice for all human beings, and a culture worthy of man's intelligence.

---